Boosting Built-In Immunity

When disturbed, an octopus changes color and emits a dark, inky fluid so that predators can't discern its location. A porcupine's needle-sharp quills fend off would-be attackers.

The plant kingdom, too, has its protective mechanisms. A fascinating example is a tiny apple growing on a tree. It can protect itself from a formidable enemy—pervasive rots.

"The problem with this protection is that as the apple matures, the protection decreases," says William S. Conway. "And this decrease occurs at a time when the fruit still needs protection."

But Conway, a plant pathologist at the ARS' Horticultural Crops Quality Laboratory in Beltsville, Maryland, is working with colleague Chenglin Yao to change this. They are genetically altering the apple to increase the protection at crucial times.

In this case, the protection is a protein—present in several commodities, including pears, tomatoes, and raspberries—that Yao found in Golden Delicious apples in storage.

This is the first time that the protein, called polygalacturonase-inhibiting protein (PGIP), has been purified from apples.

"This protein inhibits the action of polygalacturonase, an enzyme that causes fruit rot," Yao says. The enzyme is produced by *Botrytis cinerea*, a pathogenic fungus that attacks fruit after it has been harvested.

Growers control fruit rots primarily with fungicides because they have been effective. But because of health and environmental concerns, many of the "old faithful" fungicides are no longer available. Also because of these concerns, growers are faced with the need to cut down on the amount of chemical residues left on the surface of fruit during production and storage.

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Plant pathologist Chenglin Yao (left) and biological technician George Brown check apples that have been genetically engineered to produce larger amounts of a rot-inhibiting protein. (K7011-20)

Estimates vary, Conway says, but between 25 and 30 percent of food harvested in the United States is lost before it reaches consumers. This loss is due, in large part, to microorganisms that cause rots and costs millions of dollars each year. Consumers ultimately help pay for this loss in the form of increased prices.

"Postharvest losses are more devastating than those in the field because of the harvesting, handling, and storage costs already incurred," Conway says.

That is why he and Yao, an ARS molecular biologist, are trying to develop a superior Golden Delicious apple tree—one that can better protect its fruit. Yao has purified the protein found in the apples and is now cloning the gene that is responsible for producing it.

"We have cloned a segment of the gene by using information from amino acid sequences of the protein," he says. "The idea is to manipulate the gene so that it produces large amounts of the protein as the fruit gains maturity.

"Our studies show that young fruits are not very susceptible to rot pathogens. But as the fruit reaches maturity, PGIP levels get smaller and the fruit becomes more susceptible.

"It's at this point that we could put in a strong promoter to stimulate the PGIP gene to produce the maximum amount of the protein," he says.

It will be some time before Yao produces transgenic apple plants with the new gene. But once the gene has been successfully inserted into tissue-cultured plants, they will be ready for field testing. —By **Doris Stanley,** ARS.

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